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For: Elastomeric Interconnection Device and Methods for Making and Using Same

1. An elastomeric device for electrically interconnecting two or more components, comprising,

an elastomeric matrix having one or more outer surfaces;

one or more electrically conductive pathways through said matrix; and

one or more electrically conductive contact pads, wherein at least a portion of one or more of said pads is flush with or extends outward from one or more of said outer surfaces of said matrix, and wherein at least a portion of said pad is in at least intimate contact with one or more of said pathways.

2. The device of claim 1, further comprising one or more means for providing flow space into which at least a portion of said matrix may flow under compression.

3. The device of claim 2, wherein said means for providing flow space comprises one or more compressible microspheres imbedded in said matrix.

4. The device of claim 2, wherein said means for providing flow space comprises spaces formed between a plurality of raised surface asperities on one or more of said outer surfaces of said matrix.

5. The device of claim 2, wherein said means for providing flow space comprises one or more gas particles located in said matrix.

6. The device of claim 5, wherein said pathways comprise one or more conducting particles and wherein said gas particles are of a size which is about 20% or less than the size of said conducting particles.

7. The device of claim 2, wherein said means for providing flow space comprises one or more spaces formed between two or more of said pads which extend outward from said surface of said matrix.

8. The device of claim 2, further comprising one or more asperities on one or more of said outer surfaces, wherein said means for providing flow space comprises one or more spaces formed between two or more of said asperities.

9. The device of claim 2, wherein one or more of said pathways comprises a plurality of electrically conductive particles, wherein one or more of said particles extends outward from one or more of said outer surfaces, and wherein said means for providing flow space comprises one or more spaces formed between two or more of said particles extending outward from said one or more of said surfaces.

10. The device of claim 1, wherein said pathways are anisotropic and comprise up to about 25% magnetic particles by volume of said elastomeric matrix.

11. The device of claim 10, wherein a plurality of said magnetic particles are aligned to form one or more arrays of electrically isolated columns having at least one end, wherein one or more of said pads is in contact with an end of one or more of said columns of particles.

12. The device of claim 1, wherein one or more of said pathways comprises a plurality of particles aligned to form a column having at least one end, wherein one or more of said pads is in contact with at least one of said ends of one or more of said columns of particles.

13. The device of claim 1, wherein one or more of said pads comprises one or more layers of metal in at least intimate contact with one or more of said outer surfaces of said matrix.

14. The device of claim 13, wherein said pads together form an array of electrically conductive pads across one or more of said outer surfaces of said matrix.

15. The device of claim 14, wherein at least one of said components is a circuit board comprising an array of electrical contact points, (lands), and wherein said array of pads corresponds to said array of contact points on said board.

16. The device of claim 14, wherein at least one of said components is a heat sink, and wherein said matrix is isotropic to conduct heat from said circuit board to said heat sink.

17. The device of claim 14, wherein at least one of said components is a ball grid array comprising an array of solder balls, and wherein said array of pads corresponds to said array of solder balls.

18. The device of claim 1, wherein one or more of said pathways comprises a plurality of electrically conductive particles aligned in a column having at least one end particle coated with a metal, and wherein said portion of said pad, that is in at least intimate contact with one or more of said pathways, is in contact with said coated end particle and is coated with one or more metals that is compatible with said metal coating on said end particle.

19. The device of claim 1, wherein said matrix comprises one or more elastomers which retains about 90% or more of its modulus of compression over a temperature range of between about -50° C to 200° C.

20. The device of claim 1, wherein one or more of said pads has at least one outer surface, wherein at least a portion of said outer surface comprises one or more electrically conductive coatings.

21. The device of claim 20, wherein one or more of said coatings comprises one or more metallic layers.

22. The device of claim 1, wherein one or more of said pads has at least one outer surface comprising one or more asperities.

23. The device of claim 1, wherein one or more of said pathways comprise a plurality of conducting particles aligned in one or more columns having at least one end particle, and wherein one or more of said pads form a bond with said matrix and with one or more of said end particles.

24. The device of claim 1, wherein said outer surfaces of said matrix comprise a first surface adapted to face one of said components and a second surface adapted to face a second of said components, wherein one or more of said pathways extends from at least proximate to said first surface to at least proximate said second surface and wherein one or more of said pads are located on said first and second surfaces.

25. The device of claim 1, further comprising one or more support films.

26. The device of claim 25, wherein at least one of said support films is a carrier sheet.

27. The device of claim 25, wherein at least one of said support films is removable.

28. The device of claim 25, wherein one or more of said components comprises registration holes, and wherein at least one of said films comprises one or more registration holes in said film which correspond to said registration holes of said component.

29. The device of claim 25, wherein one or more of said components comprises registration holes, and wherein one or more of said films comprises one or more precision pins which correspond to one or more of said registration holes of said components.

30. The device of claim 25, wherein at least one of said films comprises one or more mounting holes in said film which are at least partially filled with said elastomeric matrix.

31. The device of claim 25, wherein at least one of said films comprises one or more contact holes adapted to receive therein at least one or more of said pads.

32. The device of claim 31, wherein at least one of said films is removable, which, if removed, will leave behind spaces between two or more of said pads into which at least a portion of said matrix may flow when compressed.

33. The device of claim 25, wherein at least one of said films comprises one or more contact holes adapted to receive therein at least one or more of said pads, and wherein at least one or more of said pads has an outer surface which protrudes from said contact holes.

34. The device of claim 25, wherein at least one of said films comprises one or more contact holes adapted to receive therein at least one or more of said pads, and wherein at least one or more of said pads has at least an outer surface which is exposed and coated with one or more metals.

35. The device of claim 1, wherein a plurality of said pads are mounted to said matrix as an applique.

36. The device of claim 35, wherein said applique comprises a support layer which holds one or more of said pads in one or more predetermined locations in said support layer.

37. The device of claim 36, wherein one or more of said pathways comprise a plurality of conducting particles aligned in one or more columns having at least one end particle proximate one or more of said outer surfaces of said matrix, wherein said predetermined locations correspond to one or more of said end particles.

38. The device of claim 36, wherein said support layer comprises two opposing sides, wherein one or more of said pads which is held in said support layer comprises two opposing ends portions which are larger in diameter than a middle portion, wherein said holes of said support layer have a diameter which is smaller than the diameters of said opposing ends, and wherein said larger opposing end portions of one or more of said pads extend outward from said opposing sides of said support layer and said middle portion of said pad is captured in said hole.

39. The device of claim 38, wherein said middle portion of said pad has a length and said pad is capable of floating up and down in said hole to the extent of said length of said middle portion.

40. The device of claim 38, wherein said pads are brass.

41. The device of claim 38, wherein said pads are molded plastic and comprise one or more conductive layers.

42. The device of claim 41, wherein said conductive layers comprise a layer of copper and one or more subsequent layers of nickel and solder.

43. The device of claim 41, wherein said conductive layers comprise a first layer of copper, a second layer of nickel and one or more subsequent layers of gold.

44. The device of claim 38, wherein said pads have one or more surfaces and comprise one or more asperities in one or more of said pad surfaces.

45. The device of claim 38, wherein said pads comprise conductive plastic.

46. A method for making an elastomeric device for electrically interconnecting two or more components, comprises the steps of,

embedding a plurality of conductive, magnetic particles in an elastomer which retains 90% of its modulus of compression over a temperature range of between about -50°C to 200°C by mixing said particles in said elastomer before said elastomer sets and applying a magnetic force to said particles so that said particles align themselves in electrically isolated columns as the elastomer sets to form an elastomeric matrix having one or more outer surfaces and comprising one or more electrically conductive pathways through said matrix;

providing one or more electrically conductive contact pads; and

fixing one or more of said electrically conductive contact pads to said matrix, so that at least a portion of one or more of said pads is flush with or extends outward from one or more of said outer surfaces of said matrix and, so that at least a portion of said pad is in at least intimate contact with one or more of said pathways.

47. The method of claim 46, further comprising the step of creating one or more means for providing flow space into which at least a portion of said matrix may flow under compression.

48. The method of claim 47, wherein said step of creating one or more means for providing flow space comprises embedding one or more compressible microspheres in said elastomer as its sets to form said matrix.

49. The method of claim 47, wherein said step of creating one or more means for providing flow space comprises forming a plurality of raised surface asperities in one or more of said outer surfaces of said matrix as said elastomer sets.

50. The method of claim 47, wherein said step of creating one or more means for providing flow space comprises the step of trapping one or more gas particles in said matrix as said elastomer sets.

51. The method of claim 46, wherein said pathways are anisotropic and comprise up to about 25% magnetic particles by volume of said elastomeric matrix.

52. The method of claim 51, wherein a plurality of said columns of magnetic particles has at least one end particle proximate one or more of said outer surface of said matrix, and wherein one or more of said pads is in intimate contact with an end particle of one or more of said columns of particles.

53. The method of claim 51, wherein said pathways comprise at least about 3% magnetic particles by volume of said elastomeric matrix.

54. The method of claim 46, wherein one or more of said pathways has at least one end particle, and wherein one or more of said pads is in intimate contact with at least one of said end particles of one or more of said columns of particles.

55. The method of claim 46, wherein one or more of said pads comprises one or more layers of metal in at least intimate contact with one or more of said outer surfaces of said matrix and one or more of said pathways.

56. The method of claim 46, wherein said pads are a known number and comprise two opposing end portions having a diameter and a middle portion having a diameter smaller than said diameter of said end portions, and wherein said step of providing one or more electrically conductive contact pads comprises the steps of,

providing one or more non-conductive, pliant support sheets comprising a plurality of holes, having a diameter smaller than said diameter of said end portion of said pads, through said sheet corresponding to said number of pads; and

pushing one of said opposing ends portions of each of said pads through one of said holes so that said pad is captured in said sheet.

57. A device package, wherein one or more chips and one or more components are electrically interconnected, comprising,

one or more layers of elastomeric material between said chip and said component, wherein at least one of said layers provide electrical contact between said chip and said component, and wherein said layer which provides electrical contact comprises,

an elastomeric matrix having one or more outer surfaces;

one or more electrically conductive pathways through said matrix; and

one or more electrically conductive contact pads, wherein at least a portion of said pad is in at least intimate contact with one or more of said pathways.

58. A device package, wherein one or more chips and one or more heat sinks are interconnected so that heat may be transferred from said chip to said heat sink, comprising,

a can having a first and second opposing surface, wherein said first opposing surface is adjacent to said heat sink;

a top layer of elastomeric material provided between said chip and said second opposing surface of said can, wherein said top layer provides thermal contact between said chip and said can;

a bottom layer of conducting elastomeric material between said chip and a lead frame, wherein said bottom layer provides electrical contact between said chip and said lead frame.

59. The device package of claim 58, wherein said bottom layer comprises elastomeric conducting polymer interconnect.